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ABSTRACT

The use of pesticides is necessary to aid in the production of food, feed and fiber, and is equally important in the control of home garden and household pests, but correct use is critical in preventing injury to persons, animals, and plants. This circular contains information on State of Pennsylvania and federal pesticide laws; different types of pesticides (with definitions); toxicity; routes of entry into the human body (dermal, inhalation, and oral); how to read and interpret the label; pesticide formulations and packaging; protective clothing and safety equipment; how to mix pesticides; safe application, disposal, storage and transportation of pesticides; and what to do if poisoning occurs. Guidelines for keeping records on pesticide use are also included. (JMM)

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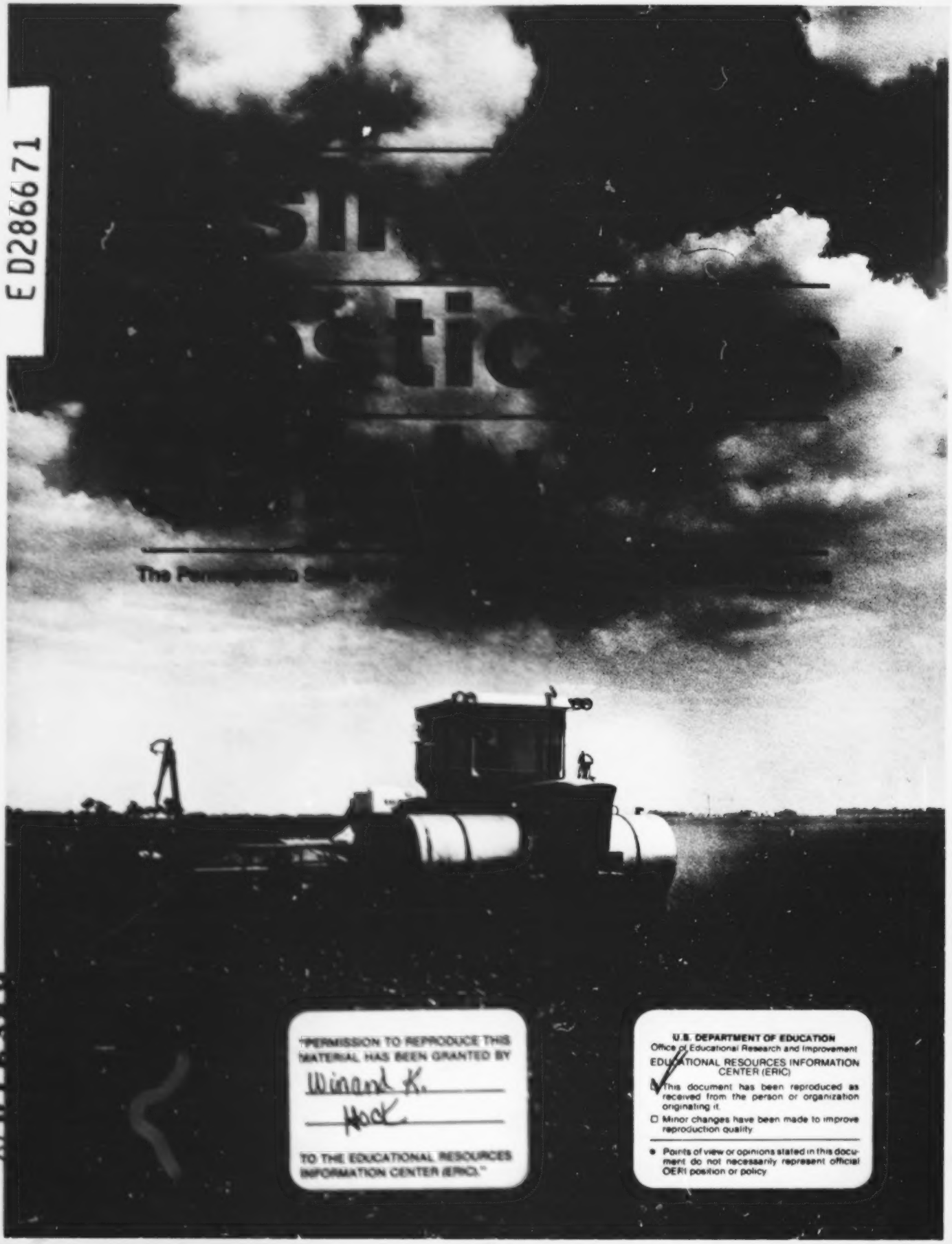

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No one really knows what would happen if farmers were denied the use of pesticides, but a number of agricultural experts have made some educated guesses. These scientists believe that without pesticides the production of crops would decrease about 35 percent almost immediately and livestock production would drop at least 25 percent. Even with currently available pesticides, losses in agricultural production and marketing caused by all kinds of pests are estimated at about $30 billion annually. Without these chemicals to protect crops, losses would have devastating consequences worldwide.

Without pesticides, it is safe to say that we could not produce commercially many of the high-quality fruits and vegetables that we now find in abundance on grocery shelves. Pests not only adversely affect agricultural productivity, but they can also impair the health of humans and domestic and wild animals and damage the environment.

Pesticides are the only efficient means yet devised to control most public health pests. Scientists estimate that about thirty major human diseases have been reduced or eliminated altogether through the use of insecticides to control pests that carry or transmit disease-causing organisms. Among the diseases suppressed in worldwide campaigns are malaria, equine encephalitis, yellow fever, bubonic plague, Rocky Mountain spotted fever, African sleeping sickness, and dengue fever. These major diseases are spread by mosquitoes, biting flies, fleas, or ticks.

Quite obviously, the use of pesticides is necessary to aid in the production of food, feed, and fiber. Pesticides are equally important in the control of home garden pests and pests of lawn, flowers, trees, and shrubs. In the home they provide protection from pests such as termites, cockroaches, and rats. We even use pesticides to control fleas, ticks, and other pests that attack our pets.

The correct use of pesticides is critical; too much of a chemical may damage or kill the plants (or animals) it was intended to protect; too little may not provide adequate control. Many desirable animals, fish, insects, and birds can be harmed by the incorrect or careless use of pesticides. And, of course, people can be harmed by careless use of or accidental exposure to pesticides.

Pesticides are here to stay, but we must use them wisely, properly, and safely.

**Pesticide Laws — State and Federal**

Since World War II the use of chemical pesticides has increased sharply. World population has seemingly exploded during this period, creating an urgent need for more and better-quality food and better disease control. Modern, sophisticated pest control chemicals are largely responsible for the high-quality, abundant food we enjoy in the United States. However, this widespread use of pesticides has had some negative side effects — an increase in health-related problems among some agricultural workers and an increase in environmental problems.

As a result, the U.S. Congress and the Pennsylvania Legislature have enacted laws regulating the production, transportation, sale, use, and disposal of all pesticides. The Federal Insecticide, Fungicide, and Rodenticide Act, originally enacted in 1947, was amended significantly in 1972 and again in 1975 and 1978 to reflect the concern of Congress and the general public over the potential negative effects of pesticides. This law, administered by the U.S. Environmental Protection Agency (EPA), is now commonly referred to as the "amended FIFRA." In addition, Pennsylvania enacted similar legislation in 1973 by passing the Pennsylvania Pesticide Control Act. This act is administered by the Pennsylvania Department of Agriculture (PDA).

These two laws, which have had a profound effect on pesticide manufacturers, dealers, and users alike, require that all pesticide products sold in Pennsylvania be registered by the U.S. EPA and by the PDA. Products are carefully screened by these two agencies to determine that the claims made by the manufacturers are valid and that the products are not unduly hazardous to man or the environment.

Each pesticide must be used in strict accordance with the instructions on the product label (the printed material that is attached to or part of the container). Any deviation from the label constitutes a misuse and subjects the user to either civil or criminal penalties. The pesticide label is a

legal document according to federal and state laws.

Another significant aspect of these laws is the requirement that all pesticides be classified as either restricted-use or general-use products. *Restricted-use pesticides may be used only by certified applicators or by persons working under the direct supervision of a certified applicator*. These certified applicators have demonstrated, by written or oral examination, competence in using and handling pesticides. General-use materials are available to anyone without restrictions unless otherwise designated on the label.

The Federal Food, Drug, and Cosmetic Act, which is also administered by the EPA, requires that maximum permissible residue levels be established for each pesticide on each edible crop. These levels or tolerances vary for different crops, even with the same pesticide. Safe residue tolerances are determined through extensive residue analyses for every pesticide applied to a food or feed crop.

Pesticide laws and regulations are largely by-products of modern technology. The widespread use of synthetic chemicals to help produce food and fiber, to protect our health, and to preserve the structures we live in has brought a demand for stricter control of all pest control chemicals. As a result, laws and regulations were written to protect the general public, the user, and the environment from the negative side effects of pesticides.

### What is a Pesticide?

A *pesticide* is any substance or mixture of substances used to kill, destroy, repel, or prevent a pest. And what is a pest? *Pests* are living organisms that bother or injure man, his plants, his animals, or his buildings. Pests can be animals such as insects, spiders, ticks, mites, rats, birds, snails and slugs, and nematodes. Pests can be plants such as weeds, and fungi (molds and rusts). Or pests can be microorganisms such as bacteria and viruses.

Pests can be controlled by a wide assortment of chemicals such as:

*Avicides* — to control pest birds;
*Bactericides* — to destroy bacteria;
*Fungicides* — to destroy fungi;
*Herbicides* — to kill weeds and other undesirable plants;
*Insecticides* — to destroy insects and related arthropods, such as ticks, spiders, or centipedes;
*Miticides (acaricides)* — to kill mites;
*Molluscicides* — to kill snails and slugs;
*Nematicides* — to kill nematodes;
*Piscicides* — to control pest fish;
*Predacides* — to control vertebrate pests;
*Rodenticides* — to destroy rodents.

Although not considered pesticides by definition, the following three classes of chemicals are regulated under both federal and state pesticide laws.

*Defoliants* — chemicals that cause leaves or foliage to drop from a plant;
*Desiccants* — chemicals that promote drying or loss of moisture in plant tissues;
*Plant-growth regulators* — substances (excluding fertilizers and other plant nutrients) that alter the normal or expected growth, flowering, or reproduction rate of plants.

Some pesticides, such as fumigants (gases), are nonspecific, controlling a wide variety of pests indiscriminately — fungi, insects, weeds, nematodes, etc. Others may kill a pest at a certain stage of its development. Ovicides, for example, kill only the eggs of insects and related arthropods.

Manufacturers of pesticides spend considerable time and money developing and testing new products before releasing them. Companies commonly test as many as 20,000 different compounds before finding a material that will become a marketable product. Costs of developing a new pesticide average around $25 million; development time often exceeds ten years.

### Toxicity of Pesticides

All pesticides must be toxic, or poisonous, to kill the pests they are intended to control. But because pesticides are toxic, they are potentially hazardous to man and animals as well as to pests. Since pesticide toxicity varies widely, it is very important for persons who use pesticides or those who regularly come in contact with pesticides to have at least a general knowledge of the relative toxicity of the products that are being used.

The toxicity of a particular pesticide is determined by subjecting test animals (usually rats, mice, rabbits, and dogs) to different dosages of the active ingredient in a pesticide product. The active ingredient is that portion of a pesticide formulation that is toxic to the pest.

The toxicity of each active ingredient is determined by at least three methods: (1) oral toxicity — by feeding the chemical to test animals; (2) dermal toxicity — by exposing the skin to the chemical and measuring its absorption through the skin into the bloodstream; and (3) inhalation toxicity — by permitting the test animals to breathe vapors of the chemical. In addition, the effect of the chemical as an irritant to the eyes and skin is examined under laboratory conditions.

Toxicity is usually expressed as LD 50 (lethal dose 50) and LC 50 (lethal concentration 50). This is the amount or concentration of a toxicant (the active ingredient) required to kill 50 percent of a test population of animals under a standard set of conditions. Toxicity values of pesticides, based on a single dosage, are recorded in milligrams of pesticide per kilogram of body weight of the test animal (mg/kg), or in parts per million (ppm). LD 50 and LC 50 values are useful in comparing the toxicity of different active ingredients as well as different formulations of the same active ingredient. *The lower the LD 50 or LC 50 of a pesticide product, the greater the toxicity of the material to man and animals*. Pesticides with high LD 50s are the least toxic to man when used according to directions on the product labels.

Pesticide products are categorized on the basis of their LD 50 or LC 50 values. Those pesticides which are classified as highly toxic on the basis of either oral,

dermal, or inhalation toxicity must have the signal words DANGER and POISON (in red letters) and a skull and crossbones prominently displayed on the package label. Effective December 31, 1984, the Spanish equivalent for DANGER, "PELIGRO," must also appear on the labels of highly toxic chemicals. As little as a few drops of such a material taken orally could be fatal to a 150-pound person. Acute (single dosage) oral LD 50s for pesticide products in this group range from a trace to 50 mg/kg.

Pesticide products considered moderately toxic must have the signal word WARNING ("AVISO" in Spanish) displayed on the product label. Acute oral LD 50s range from 50 to 500 mg/kg. From 1 teaspoon to 1 ounce of this material could be fatal to a 150-pound person.

Pesticide products classified as either slightly toxic or relatively nontoxic are required to have the signal word CAUTION on the pesticide label. Acute oral LD 50 values are greater than 500 mg/kg.

Pesticides formulated in petroleum solvents or other combustible liquids must also include the precautionary word FLAMMABLE on the product label.

Despite the fact that some pesticide products are considered to be only slightly toxic or relatively nontoxic, all pesticides can be hazardous to man, nontarget animals, and the environment if used inconsistently with the instructions on the product label. Use the pesticide only as recommended by the manufacturer. As the applicator, you are legally responsible if a pesticide is misused in any way.

### Routes of Entry

There are three principal ways a pesticide can enter the human body: (1) through the skin (dermal), (2) into the lungs (inhalation), and (3) by mouth (oral).

**Dermal route.** For most exposure situations the skin is the most important entry route of pesticides into the body. Evidence indicates that about 97 percent of all body exposure to pesticides during a spraying operation is by skin contact. If only a small amount of chemical is allowed to remain on the skin and is absorbed into the body, persons may exhibit symptoms of pesticide poisoning.

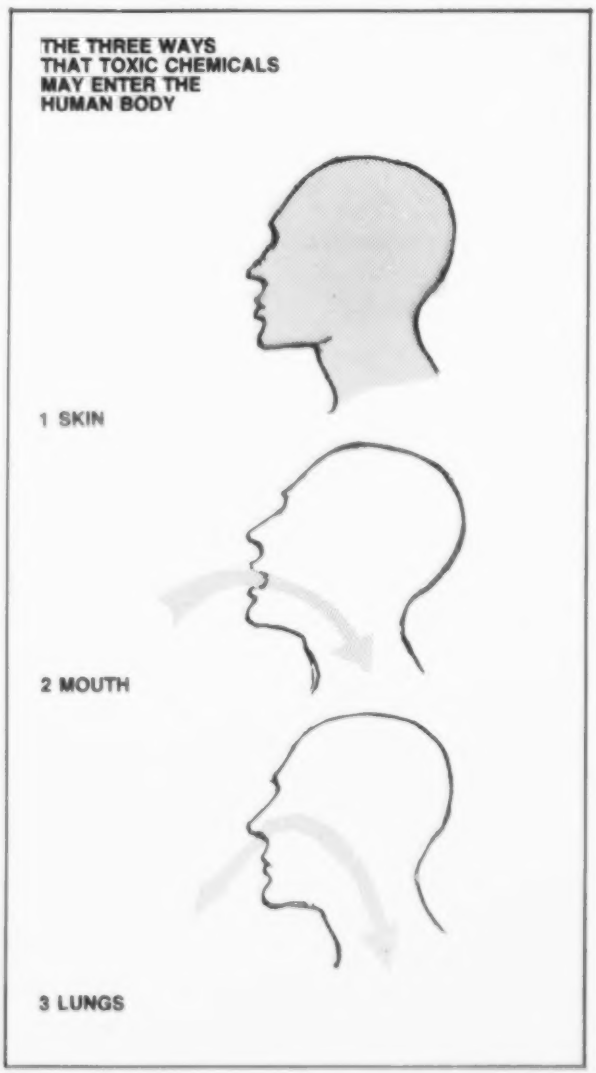
Wear protective clothing when handling pesticides. Following application and equipment cleanup, applicators should wash thoroughly to remove all traces of toxic chemicals and prevent further absorption through the skin. It is also important to change to all clean clothing.

**Inhalation route.** Protection of the lungs is especially important where toxic dusts, vapors, gases (fumigants), or very small spray particles are being applied, or where pesticides are applied in confined areas. Once breathed into the lungs, the pesticide enters the bloodstream rapidly and completely.

Respiratory protection for most types of outdoor applications can be provided by cartridge- or canister-type respirators. When fumigants or highly toxic pesticides are used in confined areas, it may be necessary to use a respirator with a self-contained air supply.

**Oral route.** The most serious oral exposure occurs when liquid concentrates splash into the mouth during mixing. A certain amount of chemical may be swallowed when eating, drinking, or smoking with contaminated hands, rubbing one's mouth on contaminated clothing, or even licking one's lips. Since many pesticides are rapidly and completely absorbed by the intestinal tract, it is sound advice to wash hands and face thoroughly before eating, drinking, or smoking.

There are several other routes of entry that are generally not as important as the dermal, inhalation, and oral routes. However, under certain conditions and with certain pesticides, absorption through the eyes or through skin abrasions can be significant and particularly hazardous. Eyes are very sensitive to many pesticides and are able to absorb a surprisingly large amount, considering their size. The eyes and any open wounds should be protected when handling pesticides.



## Reading the Label

The manufacturer of pesticides is required by law to put certain information on the label. The label must include the brand or trade name of the product, a common chemical name if one has been approved, and the full chemical designation of the active ingredient. The percentage or amount of active ingredient in the formulation must also be included, as well as information on the pests to be controlled, the crops or areas to be treated, the rate or amount of material to be used, mixing and application instructions, safety information (including signal words, proper equipment and clothing, first-aid instruction and antidotes), possible hazards to wildlife and the environment, storage and disposal instructions, reentry intervals following application, days to harvest if the pesticide will be used on an edible crop, a restricted-use statement if applicable, a statement of net contents, EPA registration and establishment numbers, and the name and address of the manufacturer. The label provides a wealth of information: READ IT CAREFULLY.

It is essential that the applicator follow all instructions in the use of agricultural chemicals to avoid injury or damage to himself, other persons, and the environment. Failure to follow the instructions on a pesticide label can result in a serious pesticide accident and constitutes a legal violation subject to civil or criminal prosecution. Remember, the label is a legal document. The user is liable for personal injury, crop damage, or pollution incurred through misuse of a pesticide.

If you do not understand the directions on the label, check with your pesticide dealer or salesman, vocational agricultural instructor, or county Extension agent for assistance.

## Pesticide Formulations and Packaging

Pesticides are available in a wide variety of formulations. It is not uncommon to find some active ingredients formulated in at least a half dozen different ways. Formulation of a pesticide is the mixing of an active ingredient with some type of carrier or diluent, either a liquid or solid material. This is done to make the chemical suitable for application with modern equipment or, in some cases, attractive to a pest (i.e., bait). Only rarely are undiluted active ingredients used to control pests.

Pesticides are available as aerosols, baits, dusts, emulsifiable concentrates, flowables, fumigants, granules, soluble powders, solutions, water dispersible granules, and wettable powders.

**Aerosols.** These pesticide formulations are liquids that contain the active ingredient in solution, packaged in a pressurized container. "Bug bombs" contain a small amount of active ingredient mixed with a propellant that forces the contents from the can in a spray or mist. The size of the cans intended for home-garden and general household use is usually in the 12- to 16-ounce range. The aerosol cylinders designed for commercial use are generally available in a 4- to 10-pound size.

Aerosols are convenient to use since no measuring or mixing of ingredients is required. They are ready to use as purchased and are easy to store. However, caution is necessary when handling aerosols. Never attempt to puncture or burn aerosol cans because they may explode into small metal fragments.

**Baits.** A poisonous bait is composed of an edible substance or some other attractant mixed with an active ingredient. The bait either attracts pests or is placed in a location where the pest animal will find it. The pest must eat the bait to be killed.

Baits may be used to control certain insects, snails and slugs, rodents and other pest mammals, and pest birds. Most bait formulations contain a low percentage of active ingredient. Baits are often used in kitchens, gardens, granaries, other food-storage and food-processing facilities, and refuse disposal areas. A major advantage is that baits can be placed exactly where and only when needed, and can be removed after use.

Disadvantages are that baits may be attractive to children and pets. Often domestic animals and wildlife are killed by these formulations. At times the target pest is not controlled by poison baits because other available sources of food are more attractive.

**Dusts.** These formulations are ready to use as purchased without additional mixing. Dusts contain an active ingredient plus a finely ground inert substance such as talc, clay, nut hulls, or volcanic ash. The amount of active ingredient usually ranges from 0.5 to 10 percent.

The major advantage of dust formulations is the ease of handling with low-cost application equipment. However, dusts are generally not good buys. They are relatively expensive for the amount of active ingredient in the total formulation; there are often problems with drift; they may be more irritating to the applicator than sprays; often little active material reaches the target host; and rain and wind easily remove dust formulations from treated surfaces. Dusts are recommended mainly for use around the home and garden but not for large-scale use on the farm.

**Emulsifiable concentrates (EC).** These are liquid formulations with the active ingredient dissolved in one or more petroleum solvents. An emulsifier is added so that the material will mix readily with water. Emulsifiable formulations usually contain between 2 and 8 pounds of active ingredient per gallon.

EC formulations (ideal for the home gardener) are easy to measure and mix. They are not abrasive and will not plug screens and nozzles. There are, however, several shortcomings associated with the use of these materials. Because of the high concentration of active ingredient(s) in EC formulations, there may be considerable hazard to the applicator and other persons if the product is accidentally spilled on the skin or consumed. They should never be stored under excessively high temperatures or where the liquid can freeze. Most of these formulations are highly flammable because of the petroleum solvent. Compatibility

and phytotoxicity (toxicity to plants) of EC materials may occasionally be a problem. Most liquid concentrates of this type can cause rubber hoses, gaskets, and pump parts to deteriorate, and some formulations are detrimental to painted surfaces.

**Flowables.** These formulations consist of finely ground solid particles suspended in a liquid carrier. The solid in a flowable is similar to the active ingredient in a wettable powder, except that the solid is formulated to stay in suspension in liquid. Normally, flowables contain 4 or more pounds of active ingredient per gallon.

Flowables can be mixed readily with water and usually do not clog nozzles. They need only moderate agitation to remain in suspension. The principal disadvantage of flowables is the hazard associated with handling and storing undiluted concentrated materials. The same precautions should be observed with flowables as with emulsifiable concentrates.

**Fumigants.** These are pesticides in the form of poisonous gases. Many fumigants are formulated as liquids under pressure and become gases only when released. Their use is generally limited to soil and closed structures such as buildings, granaries, and greenhouses. A single fumigant may kill insects, weed seeds, nematodes, rodents, fungi, and other pests. Fumigants are nonselective in their action and can penetrate into any area that is not airtight.

Fumigants are the most hazardous of all pesticide formulations, and extreme care must be taken when using these products. Protective equipment, including adequate respiratory protection devices, must be used at all times. Often fumigants are formulated with some type of warning gas, but this gas too is frequently highly toxic. Since some fumigants can severely irritate or burn the skin, fumigants are *not* recommended for use by the homeowner.

Aerosols, smokes, mists, and fogs are finely dispersed particles and thus are not considered fumigants.

**Granules and pellets.** Granular formulations are dry, ready-to-use materials normally containing from 2 to 15 percent active ingredient. Most granules are prepared by applying the active ingredient as a liquid to a coarse, porous, solid material such as clay or ground corn cobs.

Granules and pellets are ready to use as purchased and require no further mixing. Since the particles are relatively heavy, granules do not normally present a drift hazard and thus are safer to apply than most other formulations. They can be applied with relatively inexpensive equipment such as seeders and fertilizer spreaders. Granules are applied either directly to the soil or over the plants.

Although granules are more expensive to use than many other formulations, the ease of application more than offsets the added cost. Granular formulations, with few exceptions, cannot be used for treating foliage because they will not stick to plant surfaces.

**Solutions.** Many of these formulations are designed to be used without further dilution or to be diluted with specially refined oil or other petroleum solvents. Some materials in this category can be mixed with water to form true solutions. High-concentrate formulations contain 8 or more pounds of active ingredient per gallon, while low concentrates usually contain less than 2 pounds active chemical per gallon. Many are formulated with chemicals that function as spreaders and stickers.

**Water dispersible granules.** These formulations are dry, granular materials designed to be mixed with water. Upon contact with water the granules disperse or break apart. The resulting preparation has all the characteristics of a flowable formulation or a finely dispersed wettable powder.

The major advantage of a water dispersible granule is the ease of handling. The absence of dustlike particles reduces the respiratory hazard often associated with wettable and soluble powder formulations. However, since many water dispersible granules have a fairly high percentage of active ingredient, the same precautions as observed with flowables should be taken.

**Wettable powders and soluble powders.** These are dry, powdered formulations usually containing from 25 to 80 percent active ingredient. Wettable powders are mixed with water to produce *suspensions*, whereas soluble powders dissolve in water to form *solutions*. A wetting agent is often added to keep suspended particles uniformly dispersed.

As a rule, wettable powders are safer to use on foliage and usually are not absorbed through the skin as quickly as liquid formulations. They are generally easy to handle, transport, store, and mix and are relatively reasonable in cost.

Since wettable and soluble powders are dustlike in consistency, they may be hazardous to the applicator who breathes the concentrated dust during mixing. Wettable-powder suspensions need to be agitated constantly to avoid settling of the particles. Wettable powders will cause problems by clogging sprayer screens and nozzles. They are also very abrasive to spray nozzles and pumps. Very hard or alkaline water may cause some difficulty in mixing wettable powders.

Pesticides are packaged in a variety of containers, from pint containers for the home gardener to 55-gallon drums and now even bulk fiberglass containers holding upwards of 1,000 gallons. Dusts, wettable and soluble powders, granules, and other solid formulations are packaged in everything from small cellophane-wrapped bait packs and lined paper bags to cardboard and plastic containers and drums. Liquids are packaged in plastic, glass, or metal containers, the choice of container often dictated by the reactivity or corrosiveness of the liquid materials. Aerosols usually come in reinforced metal containers and cylinders. The variety of packaging materials, shapes, and sizes is endless. Pesticide recognition by container packaging is helpful, but the final authority on the nature of the chemical is the product label itself.

### Protective Clothing and Safety Equipment

The type of protective clothing and equipment needed depends on the job being done and the type of chemical being used. Read the label on the pesticide container carefully and follow all directions concerning necessary protective clothing and equipment. Many highly toxic pesticides require full protection, including a respirator, while mixing, applying, and disposing of the pesticide. In some cases, special equipment may be required, such as a self-contained air system when using fumigants.

As a minimum, the following protective items should be available when handling pesticides:

(1) Clean clothing, including a long-sleeved shirt, long trousers, and/or coveralls or a spray suit made of a tightly woven fabric or a water-repellent material. A cotton T-shirt and shorts do not provide adequate protection when applying pesticides.
(2) Waterproof gloves, unlined and without a fabric wrist band. Shirt sleeves should be worn over gloves in most instances, not tucked inside.
(3) Waterproof boots. Pants legs should be worn over boots, not tucked inside.
(4) Wide-brimmed waterproof hat.
(5) Goggles or full-face shield.
(6) Respirator with a clean cartridge or canister. Make sure you use the correct type of cartridge or canister for the chemical being applied; they differ for particular kinds or groups of toxicants. The cartridge or canister is that portion of the respirator that actually removes the harmful gases, mists, vapors, fumes, or dusts. It should be changed according to specifications, or anytime there is reason to believe noxious substances are not being removed from the air.

Wash all your protective clothing and equipment after each day's use. Do not wash your clothing with the family wash; keep it separate to avoid any possibility of cross-contamination. *Keep all your protective equipment clean and in good operating condition.*

### Mixing Pesticides Safely

The concentrated form of many pesticides is relatively poisonous through skin absorption. Rubber gloves always should be used for mixing the concentrated form of any pesticide. For very toxic materials, a respirator and eye shield should be worn to prevent inhaling the material or splashing it into the eyes. Home gardeners should never use a pesticide which is so toxic that a respirator is required.

When mixing pesticides, put water in the spray tank until it is about half full before adding the chemical. Be sure to measure accurately the proper amount of chemical according to instructions on the label. All measuring utensils (spoons, cups, etc.) should be kept in the areas where pesticides are stored. These utensils should be thoroughly washed after each use and should never be used for other purposes.

Always keep your head well above the fill hole. Do not spill or splash when filling the tank. Carefully fill the spray tank with the correct amount of water. Make sure the water hose does not come in contact with the spray preparation. This prevents contamination of the hose and avoids the possibility of back-siphoning the pesticide into the water source.

In certain cases it is possible for applicators to mix two or more pesticides together and make a single application. Charts are available which show the compatibility of different pesticides. Only those materials which are fully compatible should be mixed together. Applicators should never mix herbicides with other types of pesticides.

### Applying Pesticides Safely

*First, READ THE LABEL* carefully before applying any pesticide. Know something about the dangers of the product you intend to use. Be sure that you have properly

identified the insect, weed, disease, or other pest that you want to control. Make sure that both the pest and the host plant or animal are included on the product label, and do not apply a pesticide unless it is actually needed.

Do not permit an irresponsible or careless person to handle, mix, or apply any pesticide. He may cause harm to himself or others. Some workers cannot read the instructions on labels; others may not care. Ability and attitude are of equal importance in the safe, effective use of chemicals. Applicators should work in pairs when applying highly toxic pesticides. Immediate assistance is then available if one of the applicators becomes ill.

If two or more products are equally effective, select the least toxic material if possible. Your county Extension agent, university specialist, vocational agriculture instructor, or farm chemicals dealer can assist you in selecting the proper pesticide product for your particular pest problem.

Most important, use pesticides only on the crops for which they are recommended. An entire crop can be destroyed by spraying it with the wrong material. You can avoid this type of crop damage by carefully following the instructions on the product label.

Be sure that you wear clean clothing and use protective equipment as needed. Never eat, drink, or smoke when applying pesticides; do not even carry food or smoking items with you. Carry fresh water, soap, and paper towels with you in a container protected from the pesticide spray in case you spill the chemical accidentally on your skin and clothing or are exposed to spray drift.

Guard against drift of sprays or dusts. Drift can be reduced or controlled by making the application when there is no wind. Some chemicals are capable of drifting for miles under certain conditions, the most important factors being wind velocity and direction.

Cover all feed and water containers when treating an area around livestock, and use the same precautions when spraying or dusting around your home. People and animals can be severely injured or killed if directions are not followed. Do not spray or dust close to farm ponds where the chemicals may harm fish or livestock that drink from the ponds. Where a farm pond is used for domestic water supply, you should be especially careful not to contaminate the water. Stay a safe distance away from any pond and be sure the wind will not carry drift to the water.

Consider wildlife as well as humans, domestic animals, and plants when applying pesticides. If properly handled, pesticides can control pests without endangering wildlife.

By keeping your application equipment in good condition and operating properly, you can avoid unnecessary hazards to yourself as well as possible damage to the crop. If, while spraying, you have to stop to fix and adjust equipment that is in poor condition, you may receive excessive exposure to the chemical. Also, be sure that you are using the recommended type of equipment. For example, a powder intended to be dissolved in water should never be used in a dust applicator. The label will explain what types of applications are permissible. Use separate equipment for applying herbicides if at all possible. It is not advisable, for instance, to use spray equipment which has contained the herbicide 2,4-D for spraying insecticides or fungicides. If you use the same equipment for applying other pesticides, accidental injury to plants is likely to occur unless the equipment has been very thoroughly cleaned with an approved material. The steps in cleaning spray equipment are:

(1) Clean the sprayer thoroughly by draining the tank, pump, hoses, and nozzles and flushing with water.
(2) Fill the tank with a mixture of water and household ammonia and allow to stand overnight. (Use 2 cups of ammonia for each 10 gallons of water.)
(3) Drain and flush with clean water.

Never reenter a recently sprayed field when the foliage is still wet unless you are wearing proper protective clothing and equipment. Some pesticide labels list reentry interval times. These intervals should be strictly observed unless applicators or field personnel are properly protected against the residue. It is often desirable to post fields or structures with appropriate warning signs to reduce the possibility of someone accidentally walking into a recently sprayed area.

Immediately following application and cleaning of equipment, applicators should wash thoroughly and change to all clean clothing. The spray residue must be removed from the skin. Applicators who delay bathing and changing to clean clothing can become extremely ill because of toxic residues on the skin and clothing.

### Disposing of Pesticides Safely

Empty pesticide containers, discarded improperly, are potentially very hazardous. A number of deaths and illnesses, particularly among children, have resulted from contact with discarded pesticide containers. An empty can or drum readily entices curious children and animals and therefore should never be left exposed where it can become an attractive nuisance.

First, avoid disposal problems associated with excess pesticides by purchasing only the amount you will need for one growing season. DON'T STOCKPILE; registrations change and new chemicals may be better than old ones. Mix only as much pesticide as you will need for a particular application. If you should happen to mix too much, it is best to apply the material in the recommended manner to another of the crops listed on the label.

If you must dispose of a surplus mixture, a specially designated site at least 500 feet from any source of water should be selected. Be certain that the site does not have a high water table.

Commercial establishments and custom applicators should make sure that they are consistent with the hazardous waste guidelines established under the Federal Resource Conservation and Recovery Act (RCRA) as well as all comparable state statutes prior to disposing of pesticide wastes.

*Follow disposal instructions on the pesticide label and use adequate safety equipment and proper clothing when disposing of pesticide wastes and empty containers.*

Empty containers made of glass, metal, or plastic should be rinsed three times with water prior to disposal. Use the rinse water in the spray tank. After rinsing, containers should be punctured, broken, or crushed and then buried at least 18 inches deep in a properly designated burial site away from streams and other water supplies. Disposal of triple rinsed containers in a sanitary landfill is permissible, but it is a good policy to check with your local solid waste authority prior to discarding any pesticide containers.

Combustible containers can be burned (if permitted by the instructions on the label and local ordinances) or disposed of in a sanitary landfill. Do not burn pesticide containers near residential areas or where persons can come in contact with the smoke. Always stand upwind when burning pesticide containers; the smoke may contain toxic vapors.

Large metal drums should be sent to a barrel-reconditioning company if possible or handled the same way as small noncombustible containers. *Never reuse empty pesticide containers for any other purpose.*

Homeowners may dispose of small quantities of pesticide waste through a municipal refuse collection service. Liquid formulations in quantities of less than 1 gallon should be left in the original container. Make sure the cap is closed securely and then wrap the container in several layers of newspaper (tie or tape the newspaper if needed) before placing in a trash receptacle. Dry formulations (up to 10 pounds) should also be wrapped securely with paper or placed in a carton prior to disposal in a trash container. Homeowners should handle empty pesticide containers in a similar way.

If a leak or spill occurs, clean it up immediately. Scatter sawdust, pet litter, or some other adsorbent material over the spilled pesticide, then sweep this up, scatter lime over the contaminated area, and wash the area thoroughly with detergent and water. Dispose of the contaminated adsorbent, lime, and wash water in a proper disposal site. Always be sure to clean up thoroughly and change to clean clothing after handling or disposing of pesticides.

If you have a serious accident or have problems during the cleanup phase, you should contact the Chemical Transportation Emergency Center (CHEMTREC) in Washington, D.C., telephone (800) 424-9300. The CHEMTREC office is staffed twenty-four hours a day by trained personnel who are knowledgeable in handling emergencies involving pesticides, including spills and accidents.

### Storing Pesticides Safely

Always store pesticides and other chemicals in their original containers with the label attached and the lid closed securely. Using soda-pop bottles, fruit jars, or other types of nonpesticide containers can have serious consequences. Small children as well as most adults associate the shape of the container with its contents. Consequently, a child or an adult may be seriously poisoned or even killed.

Keep all pesticides out of the reach of children, pets, and irresponsible people. Do not store them in your home near food. This will help reduce the exposure hazard and also prevent possible contamination of food. LOCK all chemicals in a building or cabinet. The lock should keep everyone out of the chemicals except those who are qualified to use them. Also, be sure to identify the storage facility with a sign which clearly indicates that pesticides are stored in the structure.

Do not store pesticides near livestock and pet feeds to prevent possible contamination. Livestock and pets may be killed in this manner. Contamination of crop seeds by pesticides can reduce or prevent germination. Seed that is intentionally treated with a fungicide or an insecticide presents a potential hazard if not stored properly. Such seed is usually treated with a brightly colored dye which serves as a warning that the seed has been treated with pesticide. Unfortunately, the brightly colored seed may be attractive to children. Treated seed should never be used for food or livestock feed or mixed with untreated seed. It should be handled with the same care as the pesticide itself and stored in a locked storage facility away from feed, veterinary supplies, pesticides and other farm chemicals, and farm equipment.

Herbicides should be stored separately from other types of pesticides; the danger of cross-contamination is too great. Never store respirators and other safety equipment in the same room with pesticides because of possible contamination. Maintain all safety equipment in top working condition.

Never lend a portion of a pesticide in an unmarked or unlabeled container. Other people may use the pesticide by mistake and injure themselves or others. Those who use the pesticide do not have the label with directions for its proper, safe use, and relying on verbal directions is a poor practice.

Pesticides in large containers, which are heavy to handle, should be stored on or near the floor to prevent their falling. Extremely heavy containers should always be placed on the floor, never on shelves. Containers should not extend beyond shelving or cabinets where they may be bumped, knocked off the shelf, broken open, and spilled.

Check containers frequently for leaks and breaks. If a leak or break does occur, transfer the contents to an empty container which originally held the same material. Otherwise, dispose of the contents in the prescribed manner. Clean up spilled pesticides promptly and thoroughly using proper safety equipment during the cleanup procedure. Dispose of the pesticide waste in a proper manner.

Be especially careful that corrosive materials are stored and handled in containers designed for such materials. A corrosive material in the wrong kind of container may corrode the container and cause serious damage.

Pesticides in glass bottles should not be stored near heat, where glass containers can break or explode, spreading the

chemical over a large area. Materials in glass containers should be stored in dry, cool areas. However, it is necessary to protect some of them from freezing, so check the label carefully for proper storage information.

To be sure that the label remains on the container in readable condition, protect it with transparent tape or lacquer if the pesticide is to be stored for a long period. Remember, the label is the most important safety factor in the use of pesticides. Do not let it become damaged or destroyed.

Keep an inventory of all pesticides and mark each container with the date of purchase. If a product has an effective shelf life recorded on the label, you will know exactly when expiration occurs if you have marked the purchase date on the label.

It is a good idea to inform your local fire department if you store large quantities of agricultural chemicals, including fertilizers. Chemical fires often cannot be extinguished by ordinary means, and the smoke from the fire can be extremely hazardous to firefighters. The fire department must be properly prepared in the event of an agricultural chemical fire.

The name of your physician, hospital, and nearest Poison Control Center should be posted in a prominent location in the storage facility. Remember to consult the product label for specific storage information.

### Transporting Pesticides Safely

Never transport pesticides inside the passenger compartment of any vehicle. No one should be permitted to ride near pesticides. In a vehicular accident, a pesticide spill might result in injury or even death to the occupants.

Secure pesticides in the trunk of a car or back of a truck so they cannot roll or slide around. Never carry food, livestock feed, fertilizers, or seed together with pesticides. The danger of contamination is too great. It is a good policy to transport weed control chemicals separately from all other pesticides, since a spill could lead to cross-contamination.

Never leave your vehicle unattended when transporting pesticides in an open-bed truck. You are legally responsible if curious children or careless adults are accidentally poisoned from pesticides left unattended and exposed in your vehicle. Always haul pesticides in the trunk or in a secure compartment which can be locked.

If a spill does occur, clean it up immediately. Always follow the instructions on the label regarding the use of protective clothing and proper disposal of the waste material.

### If a Poisoning Occurs

Above all, know how to recognize symptoms of pesticide poisoning. These may appear immediately after exposure or not for several hours or even days. Symptoms can include headache, giddiness, sweating, blurred vision, cramps, nausea, vomiting, diarrhea, numbness, changes in heart rate, general muscle weakness, difficulty in breathing, pinpoint pupils, rashes, and allergic reactions; in advanced poisoning cases there may be convulsions and coma which ultimately could lead to death. The symptoms could be mistaken for brain hemorrhage, heat exhaustion or heat stroke, pneumonia, asthma, respiratory and intestinal infections, and several other illnesses.

Know the general poisoning symptoms for the pesticides being used in your area. If at any time after exposure to a pesticide a person does not feel well, *get him to a doctor or hospital at once*. Take the pesticide label or the container with you if at all possible. The doctor needs to know what ingredients are in the pesticide. Often an antidote is listed right on the label.

If you use pesticides or reside near areas where pesticides are used, you should have the name and number of the nearest Poison Control Center readily available. There are times when you and the doctor may have to use the services of a center. The centers are staffed on a twenty-four-hour basis. Contact your local hospital, physician, or agricultural Extension agent to determine the nearest Poison Control Center in your area.

There may be times when immediate action is necessary to prevent serious and often permanent injury to the victim of pesticide poisoning. It could indeed be a life-and-death matter in certain situations. It may be necessary for someone to administer first aid to the victim.

**If the pesticide has been spilled on the skin or clothing.** Strip off all clothing immediately and thoroughly wash the skin with soap and water. Some pesticides are absorbed through the skin very rapidly. It may be best to dispose of the contaminated clothing, but if you decide to wash the clothing do not wash it with the family wash; keep it separate to avoid any possibility of cross-contaminating the family clothes.

**If the pesticide has been inhaled.** First, get the victim to fresh air. Have him lie down and loosen all clothing. Keep the victim warm and administer first aid if needed. Contact a physician or the nearest Poison Control Center as soon as possible.

**If the pesticide has been swallowed.** The most important choice one must make when aiding a person who has swallowed a pesticide is whether or not to induce vomiting. The decision must be made quickly and accurately; the victim's life may depend on it. Usually it is best to void the swallowed poison fast, *but:*

*NEVER* induce vomiting if the victim is unconscious or is in convulsions. The victim could choke to death on the vomitus.

*NEVER* induce vomiting if the victim has swallowed petroleum products (kerosene, gasoline, oil, lighter fluid) unless so directed by the label or by a physician. Many pesticides which are formulated as emulsifiable concentrates are dissolved in petroleum products. The words "emulsifiable concentrate" on the pesticide label are signals *NOT* to induce vomiting without first

consulting the product label or a physician. Petroleum products aspirated into the lungs can cause serious respiratory disorders. If a person swallowed a *dilute* preparation, he should be forced to vomit immediately.

*NEVER* induce vomiting if the victim has swallowed a corrosive poison — a strong acid or alkali (base). Determine what poison the person has ingested. The victim may experience severe pain and have extensive mouth and throat burns. A corrosive poison will burn the throat and mouth as severely coming up as it did going down.

To *neutralize acids* — If you are sure the poison is an acid, give the victim milk of magnesia (1 tablespoon to 1 cup of water) or baking soda in water.

To *neutralize alkali* — If you are sure the poison is an alkali, give the victim lemon juice or vinegar.

**How to induce vomiting.** Do not waste a lot of time inducing vomiting. Use it only as first aid until you can get the victim to a hospital. Make sure the victim is lying face down or kneeling forward while retching or vomiting. Do not let him lie on his back because vomitus could enter the lungs and do additional damage.

First give the patient large amounts of water to dilute the poison. Give at least 1 to 2 glassfuls to victims. Do not use carbonated beverages.

If possible, use ipecac syrup to induce vomiting. This material is extremely effective in emptying the stomach contents and is available in small quantities on a nonprescription basis from most drugstores. If ipecac syrup is not available, put your finger or the blunt end of a spoon at the back of the throat. Do not use anything sharp or pointed! Never use salt water to induce vomiting.

Collect the vomitus for the doctor; he may need it for chemical tests.

**Activated charcoal.** After vomiting has occurred, give the patient 2 to 4 tablespoons of activated charcoal in water. Never administer activated charcoal at the same time as ipecac syrup, because the charocal will adsorb the ipecac. Activated charcoal absorbs many poisons at a high rate. It is available from most drug stores. In a poisoning emergency, "GroSafe," a commercial preparation of activated charcoal, may be substituted for a pharmaceutical grade of activated charcoal.

*Only first aid has been discussed here. Be sure to get the victim to a doctor or hospital as soon as possible and take the pesticide label with you.*

## Keeping Records

Every person using pesticides should keep careful, written records of each application. He should write down:

(1) Date and time of application;
(2) Type of equipment used;
(3) What pesticide was used;
(4) The formulation;
(5) The way it was mixed (e.g., how many pounds per gallon water);
(6) Rate of application (e.g., gallons per acre) and total area treated;
(7) What crop or site was treated (e.g., corn, ornamentals, house foundation);
(8) What pest was controlled;
(9) Weather conditions at time of application;
(10) Name of applicator;
(11) Miscellaneous comments.

Certified applicators who use restricted-use pesticides are required to keep records for two years, although all users of pesticides should keep records for their own protection. If a farmer's crop is seized for having an illegal residue, the application records may prove that the pesticides were not used illegally.

Your personal protection is not the only reason for keeping pesticide application records. Many herbicides can be used safely on certain crops, but may be fatal to others. Without written records it is difficult to know what pesticides have been used on a field during the previous few years.

## Summary

The best way to avoid the hazards of pesticides is to know what you are using and how to use it. The only way you can be sure of this is to *read the label*. Most pesticides are safe when properly used.

The attitude of the user is of utmost importance. If a user mistakenly thinks he or she knows exactly how to use a pesticide, or does not care what precautions should be taken to prevent injury to persons, animals, or plants, injury or crop damage is likely to occur. If such users realized the legal and moral obligations in using pesticides, they would be more apt to read the label and follow the instructions closely.

Merely reading the label will not insure safety; the instructions must be followed. By taking adequate precautions and practicing good management with safety in mind, there should be few accidents from the use of pesticides.

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